

Identification and Evaluation of Integration and Cross Cutting Issues Across HRP Risks

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The HRP Integrated Research Plan contains the research plans for the 32 risks requiring research to characterize and mitigate. These risks to human health and performance in spaceflight are identified by evidence and each one focuses on a single aspect of human physiology or performance. They are further categorized by aspects of the spaceflight environment, such as altered gravity or space radiation, that play a major role in their likelihood and consequence. From its inception the “integrate” in the Research Plan has denoted the integrated nature of risks to human health and performance, the connectedness of physiological systems within the human body regardless of the spaceflight environment, and the integrated response of the human body to the spaceflight environment. Common characteristics of the spaceflight environment include altered gravity, atmospheres and light/dark cycles, space radiation, isolation, noise, and periods of high or low workload. Long term exposure to this unique environment produces a suite of physiological effects such as stress; vision, neurocognitive and anthropometric changes; circadian misalignment; fluid shifts, deconditioning; immune dysregulation; and altered nutritional requirements. Matrix diagramming was used to systematically identify, analyze and rate the many-to-many relationships between environmental characteristics and the suite of physiological effects. It was also to identify patterns in the relationships of common physiological effects to each other. Analyses of patterns or relationships in these diagrams help to identify issues that cut across multiple risks. Cross cutting issues benefit from a multidisciplinary approach that synthesizes concepts or data from two or more disciplines to identify and characterize risk factors or develop countermeasures relevant to multiple risks. They also help to illuminate possible problem areas that may arise when a countermeasure impacts risks other than those which it was developed to mitigate, or identify groupings of physiological changes that are likely to occur that may impact the overall risk posture.